LAW OFFICES
ARTHUR B. CUNNINGHAM
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November 22, 2010

Robert R. Scott, Director
Air Resources Division
New Hampshire Department of Environmental Services
79 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Hand Delivered

Re: Proposed Rule, Chapter Env-A 2300, Mitigation of Regional Haze

Dear Mr. Scott:

I represent the New Hampshire Sierra Club [NHSC].

First, I want to thank you and Craig Wright for extending the time in which to submit comments on Proposed Rule Chapter Env-A 2300 and for the prompt rejection of the Public Service Company of New Hampshire [PSNH] confidentiality claims regarding information critical to the assessment of the rule. NHSC has long believed that PSNH uses the claim of confidential business information [CBI] as an artifice to conceal facts regarding compliance with the Clean Air Act and the New Hampshire Multiple Pollutant Control Program. I also want to thank Liz Knowland and Pete Demas for their help and cooperation in my substantial 91A document review of the Regional Haze documents.

You have determined that the July 17, 1998, NOx RACT Order for Merrimack Station MK2 satisfies the Regional Haze BART requirement. The 1998 NOx RACT Order requires that MK2 emit no more than 15.4 ton s of NOx per each 24 hour calendar day. In the BART analysis, 15.4 tons per day equates to 0.37lbs/MMBtu.of NOx.

NHSC rejects your determination that the MK2 RACT Order satisfies BART.[1]

[1] .37 lbs/MMBtu is almost four times the presumptive .1lbs/MMBtu BART emission limit set forth in 40 CFR 51, Appendix Y.

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New Hampshire Department of Environmental Services-Air Resources Division [ARD] review of the Regional Haze BART requirement for Merrimack Station intersects with the legal necessity of ARD review of the New Hampshire nonattainment program, particularly for NOx, a major component of both regional haze and ozone.

ARD is required by the Clean Air Act to timely establish a NOx emission limit for Merrimack Station MK2 that satisfies both the Regional Haze BART requirement and the nonattainment program. New Hampshire is delinquent in the establishment of both programs.

The New Hampshire Regional Haze state implementation plan [SIP] was due to the United States Environmental Protection Agency [EPA] on December 17, 2007. On January 15, 2009, EPA made a finding that New Hampshire failed to timely submit addressing Regional Haze in mandatory class I federal areas [the nations National Parks and wilderness areas]. By January 15, 2011, EPA is required to fully approve the New Hampshire Regional Haze SIP or promulgate a federal implementation plan [FIP]. Exhibit 1.

On March 17, 2008, EPA issued a finding that New Hampshire missed the Clean Air Act deadline for submitting complete plans showing how the state will meet the 1997 ozone standards which must include an attainment demonstration, a reasonable progress plan, and, a reasonably available control technology plan.[RACT]. Exhibit 2. On January 19, 2010, EPA determined that the states must submit their attainment designations to EPA by January 7, 2011, for the primary ozone standard [1 hour], and August 31, 2011, for the secondary standard [8 hour]. Federal Register, Vol. 75, No. 11, January 19, 2010.

As you know, a large part of southern New Hampshire has not attained the NAAQS for ozone and a substantial portion of the nonattainment area is in serious nonattainment. The ozone NAAQS are required to provide protection of the public health against an array of ozone related adverse health effects that range from decreased lung function and respiratory symptoms to serious indicators of respiratory morbidity including emergency room visits and hospital admissions for respiratory causes; cardiovascular related morbidity and cardiopulmonary mortality.

The Merrimack Station MK2 emission limit for NOx to achieve attainment will be significantly more stringent than the July 17, 1998, NOx RACT Order:

1. PSNH has increased the historic net generating capacity of MK2 from 320 MW to an ISO NE capacity claim of 338 MW. PSNH is currently operating MK2 at 332 MW. Exhibit 3. NHSC <u>rejects</u> the PSNH claim that the generation upgrade is entirely due to increased efficiency of the replaced MK2 turbine.[2] <u>ARD has failed to examine this generation upgrade and its impact on emissions.</u>

2. NOx is a particularly demanding problem for MK2. The uncontrolled NOx levels are 2.4 lbs/MMBtu [average] and 2.66 lbs/MMBtu [maximum] which is a much higher emission rate than most uncontrolled boilers and is higher than most other cyclone boilers. The high emission rate is due to the very high heat release for the boiler. Exhibit 4.

3. The MK2 SCR cannot be operated fulltime because of a temperature permissive. During start-ups, shutdowns and low load operations [below 230 MW net] the SCR cannot operate. Exhibit 5. PSNH asserts that the uncontrolled NOx rate is typically 1.0-1.5 lbs/MMBtu. PSNH, because of these concerns, insists that it needs "flexibility" to operate the SCR at a much higher emission limitation.[3] Existing ARD data does not support the PSNH claim that MK2 emits only 1.0-1.5 lbs/MMBtu during low load operations with the SCR shut down. <u>ARD must examine the integrity of the PSNH low load emission claim because it is a critical part of the BART emission calculation as it exists in the proposed Regional Haze SIP</u>. See PSNH MK2 NOx Control Cost Analysis, Exhibit 6. ARD must fix a NOx emission limit that fully accounts for the periods when the SCR is not in operation.

The MK2 NOx emissions problem must be addressed in both the Regional Haze program and the nonattainment program. It makes <u>no sense whatever</u> to fix a 0.37 lbs/MMBtu BART emission limit for NOx knowing that a more stringent attainment NOx limit is due.

PSNH, in its confidential submissions to ARD ordered released by ARD, asserts that it will be too expensive [$10,169 per ton at 0.34 lbs/MMBtu] if it cannot maintain the de-rate flexibility at 0.37 lbs/MMBtu. Exhibit 7. If the

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[2] NHSC has appeals pending before the NHDES-ARC that raise substantial NSR permitting issues. [09-10 ARC and 10-06 ARC]. Proper NSR permitting for the major plant modifications, including the replaced MK2 HP/IP turbine and related plant projects, will require significantly more stringent NOx emission limits. The lowest achievable emission rate [LAER] is required for modified sources in nonattainment areas.

[3] Data contained in ARD files indicate that MK2 NOx removal is, on average, below the .37 lbs/MMBtu NOx RACT limit.

PSNH cost claims are correct, PSNH will not be able to meet its Clean Air Act obligations under the secondary standard attainment program.

NHSC strongly urges ARD to establish an emission limit for MK2 in the Regional Haze SIP that will bring New Hampshire into attainment for ozone as required by the Clean Air Act.

Very truly yours,

Arthur B. Cunningham
Attorney for New Hampshire Sierra Club

Electronic copies to:

Catherine M. Corkery, Chapter Director, NHSC
Jerry Curran, Chapter Chair, NHSC
Donald Dahl, EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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BOSTON MA 02109-3912

NHSC J 1

FEB 2 9 2010

Thomas S. Burack, Commissioner
New Hampshire Department of Environmental Services
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Re: New Hampshire's Regional Haze State Implementation Plan

Dear Commissioner Burack:

As you know, on January 15, 2009, the Environmental Protection Agency (EPA) made a finding that the state of New Hampshire failed to submit a state implementation plan (SIP) addressing Regional Haze in mandatory class I Federal areas (our Nation's National Parks and wilderness areas) as required by the Clean Air Act (CAA) and federal regulations. The Regional Haze SIP was due to EPA by December 17, 2007. As a result of this finding, EPA must within two years (that is, by January 15, 2011) either fully approve New Hampshire's Regional Haze SIP or promulgate a federal implementation plan (FIP).

On January 29, 2010, the New Hampshire Department of Environmental Services (DES) submitted a final Regional Haze SIP to EPA. We have reviewed New Hampshire's submittal and note that it appropriately addresses many of the necessary components of a Regional Haze SIP. The plan is, however, incomplete with respect to best available retrofit technology (BART) requirements. Consequently, the BART portion of the submittal can not be processed as a revision to the New Hampshire SIP and EPA is returning that portion of the submittal to the DES. Therefore, the incomplete BART portion is no longer pending EPA action.

Specifically, in order for EPA to determine a SIP revision complete, it must include the necessary administrative and technical support materials to meet the criteria outlined in 40 CFR Part 51, Appendix V. New Hampshire's January 29, 2010 Regional Haze SIP submittal does not meet these criteria with respect to BART requirements. In particular, the SIP submittal lacks enforceable emission limitations, work practice standards and recordkeeping/reporting requirements, to ensure BART requirements are implemented.

In addition, EPA is very concerned with the BART rulemaking schedule outlined in the SIP submittal. This schedule calls for a rough draft of the BART rule in January 2012 and a final rule to be adopted in May 2013. As noted above, EPA's deadline to issue a FIP is January 15, 2011.

Also, New Hampshire has not yet submitted an adopted regulation implementing the state's low sulfur fuel oil measure which was included as an element of New Hampshire's long term Regional Haze strategy.

EXHIBIT 1

Therefore, we would like to request a meeting with your Air Director and staff working on the Regional Haze SIP to further discuss this issue, in order to ensure these requirements are met in a timely and effective manner.

My staff will contact DES staff to schedule a mutually acceptable time for this meeting. If you or your staff have any questions on Regional Haze issues, please contact Anne McWilliams at 617-918-1697.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystems Protection

cc Robert R. Scott, NH DES
Jeff Underhill, NH DES
Charles Martone, NH DES

Fact Sheet - Managing Ozone Air Quality: Findings on Failure to Submit Elements of 1997 Ozone NAAQS State Implementation Plan

ACTION

- On March 17, 2008, the U.S. Environmental Protection Agency (EPA) issued findings that 11 states missed Clean Air Act deadlines for submitting elements of their State Implementation Plans (SIPs). The deadlines are for submitting complete plans showing how they will meet the 1997 ozone standards; they are not deadlines for meeting those standards.

- These elements are an attainment demonstration, a reasonable further progress plan, and a reasonably available control technology plan.

- Today, EPA has taken a separate action that helps ensure that all states have in place the basic program requirements for attaining the 1997 ozone air standards; For more information please see www.epa.gov/air/ozonepollution/fs20080317b.html.

- The 11 states are: California, New Hampshire, New York, Rhode Island, Illinois, Indiana, Maine, Ohio, Vermont, Virginia, and Wisconsin. (See attached for a list of specific overdue elements.)

- The plans that were due are known as state implementation plans, or SIPs, and are required by States in one or more of the following situations:
  - States with ozone nonattainment areas: these areas must submit SIPs to show how those areas will meet the ozone standard by their attainment dates.
  - States in the Ozone Transport Region (OTR): the Clean Air Act set out specific requirements for a group of northeast states that make up the OTR. States in this region are required to submit a SIP and install a certain level of controls for the pollutants that form ozone, even if they meet the ozone standards.

- For ozone nonattainment areas, the Clean Air Act requires EPA to start three timetables, known as "clocks" once these findings are published in the Federal Register. The three clocks include two sanctions clocks, and a deadline for EPA to issue federal implementation plans (FIPs). These clocks range from 18 months to two years.

- For areas currently attaining the standard, but falling within the Ozone Transport Region, this finding of failure to submit starts the emission offset sanction clock and the FIP clock. Because these areas are attaining the 1997 ozone standard, this finding does not start the highway fund sanction clock.

- Sanctions will not apply to states that submit complete SIPs before these clocks run out and EPA will not issue FIPs for states with plans approved before the FIP deadline. EPA is working with these states to ensure that they submit revised, approvable plans as soon as possible.

EXHIBIT 2

- EPA has proposed a clean air determination for New York and finalized a clean air determination for New Hampshire. These determinations, when finalized, will suspend certain SIP requirements and any active sanction clocks as long as the areas maintain clean air.

The Clocks

- **Emission offset sanctions (18 months)**: Under emission offset sanctions, a state must ensure that each ton of emissions created by a new stationary source of pollution is offset by a two ton reduction in existing stationary sources. These offset requirements would apply in areas designated as "nonattainment" for the ozone standard. Emission offset sanctions will not apply to states that submit complete SIPs within 18 months after these findings are published in the Federal Register.

- **Highway fund sanctions (two years)**: Under highway fund sanctions, a state can lose funding for transportation projects if the funds have not been obligated by the Federal Highway Administration by the date the highway sanctions are imposed. (Projects that have already received approval to proceed and had funds obligated may proceed.) Highway sanctions will not apply to states that submit complete SIPs within 24 months of publication of these findings.

- **Federal Implementation Plans (two years)**: Under a FIP, EPA, not the state, determines what steps must be taken to meet the standard. For the FIP clock to be turned off, EPA must approve the SIPs within 24 months of publication of these findings.

BACKGROUND

- Ground-level ozone forms when emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs) "cook" in the sun. Ozone exposure is linked to acute respiratory problems, aggravated asthma, reduced lung capacity, inflamed lung tissue, and impairment of the body's immune system.

- SIPs include a number of documents and programs designed to address ground level ozone pollution. These findings apply to three plan elements: an attainment demonstration, the Reasonably Available Control Technology (RACT) elements and the Reasonable Further Progress (RFP) element.

  Attainment demonstration

  - States with nonattainment areas are required to analyze the potential of those areas to meet the 1997 ozone standard. The state uses air quality models and other relevant technical information to demonstrate its ability to achieve the air quality standard by a certain date. (In the findings issued March 17, 2008, states with ozone nonattainment areas classified as moderate or higher are required to show they can meet the standard "as expeditiously as practicable," but no later than the statutory attainment date for the respective classification. These attainment demonstrations were due to EPA in June 2007.)

  Reasonably Available Control Technology

  - The Reasonably Available Control Technology (RACT) SIP element identifies certain levels of air pollution control for existing stationary sources of NOx and VOCs. RACT is defined as the lowest emissions limitation that a particular emissions source is capable of meeting with control technology that is reasonably available, considering technological and economic feasibility. The RACT requirement also applies to all areas in the Ozone Transport Region, regardless of the area's designation for the 1997 ozone standard. This SIP element was due to EPA in September 2006.

Reasonable Further Progress

- SIPs must also provide for steady progress, also known as Reasonable Further Progress (RFP), toward attainment of the ozone standard. This provides a way to ensure states make continual progress toward meeting the standard by their attainment date. This SIP element, which was due in June 2007, establishes emission reduction milestones for the first six years after a baseline year (in most cases, the baseline is 2002), and every three years afterward until the attainment year.

- States that are part of the Ozone Transport Region were required to submit SIPs to meet the 1997 ozone Reasonably Available Control Technology (RACT) requirement for the entire State. The RACT requirement applies to all areas within the Ozone Transport Region, regardless of the area's designation for the 1997 ozone standard.

- The states in the Ozone Transport Region are: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, and the Washington, D.C. Metropolitan Statistical Area, including the northern Virginia suburbs.

FOR MORE INFORMATION

- To download a copy of this notice, please go to www.epa.gov/air/ozonepollution/ and click on "Regulatory Actions." For further information concerning this action, contact Mr. Butch Stackhouse of EPA's Office of Air Quality Planning and Standards at (919) 541-5208 or by email at stackhouse.butch@epa.gov.

States and Areas Receiving Findings of Failure to Submit

State	Affected Area(s)	SIP Element(s) Not Submitted
California	W Mojave Desert	Reasonable Further Progress SIP
	Sacramento Metro Area	Reasonable Further Progress SIP
	Ventura County (part) Area	Reasonable Further Progress SIP
New Hampshire	Boston-Manchester-Portsmouth (SE)	Attainment Demonstration Reasonable Further Progress SIP
New York	Jefferson County Area	Attainment Demonstration Reasonable Further Progress SIP
Rhode Island	Providence (all of RI) Area	Attainment Demonstration RACT SIPs Reasonable Further Progress SIP
Illinois	Chicago-Gary-Lake County Area	Attainment Demonstration RACT SIPs Reasonable Further Progress SIP
	St. Louis Area	NOx RACT
Indiana	Chicago-Gary-Lake County Area	Attainment Demonstration RACT SIPs

		Reasonable Further Progress SIP
Maine	Entire State in Ozone Transport Region (OTR)	VOC RACT SIP
	Entire State minus areas receiving NOx waiver	NOx RACT SIP
Ohio	Cleveland-Akron-Lorain Area	VOC RACT SIP
Vermont	Entire State in Ozone Transport Region	NOx and VOC RACT SIPs
Virginia	Stafford County Portion of the OTR	NOx and VOC RACT SIPs
Wisconsin	Milwaukee-Racine Area	Attainment Demonstration Reasonable Further Progress SIP
	Sheboygan Area	Attainment Demonstration Reasonable Further Progress SIP

Public Service Company of New Hampshire
Docket No. DE 10-121

Data Request SCNH-02

Dated: 08/13/2010
Q-SCNH-004

Witness: William H. Smagula
Request from: Sierra Club, New Hampshire Chapter

Question:
William H. Smagula, Director-Generation, PSNH, in response to Q-Staff-059, listed a number of projects that improved the fossil unit heat rates, including the HP/IP turbine project. In response to Q-Staff-022, Mr. Smagula stated that the net energy of 12 MW was due to equipment gains. Mr. Smagula also stated that an additional unit capacity of just over 5 MW was demonstrated. He did not attribute the 5MW+ increase to efficiency gains. Please provide the documentation that supports Mr. Smagula's responses, both as to the efficiency gains and the additional unit capacity.

Response:
Merrimack Unit 2 receives capacity credit for 338 MW associated with the turbine project efficiency gains as shown on the ISO web page.

The unit operates at approximately 332 MW (12 MW above the previous 320 MW net operation) due to efficiency gains associated with the turbine project as shown below.

Historical operation at 320 MW				Increased output at 332 MW (Improved turbine efficiency)		
date	hour	Net Gen MW		date	hour	Net Gen MW
01 Jan 10	01	321.15		06 Jan 10	13	332.35
01 Jan 10	02	320.95		06 Jan 10	14	332.25
01 Jan 10	03	320.60		06 Jan 10	15	331.65
01 Jan 10	04	320.70		06 Jan 10	16	332.90
01 Jan 10	05	320.70		06 Jan 10	17	333.10
01 Jan 10	06	320.50		06 Jan 10	18	331.95
01 Jan 10	07	320.60		06 Jan 10	19	332.15
01 Jan 10	08	320.55		06 Jan 10	20	331.85
01 Jan 10	09	320.85		06 Jan 10	21	331.40
01 Jan 10	10	320.90		06 Jan 10	22	331.20
01 Jan 10	11	321.00		06 Jan 10	23	331.60
01 Jan 10	12	320.70		06 Jan 10	24	332.20

EXHIBIT 3

NHSC B.11

Andover Technology Partners

Recipient:	Mr. Andy Bodnarik	Sent By:	James E. Staudt
Company:	NH DES	Company:	Andover Technology Partners
Fax Number:	1 (603) 271-7053	Fax Number:	1-978-683-3843
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Date: 4/23/98

Time: 6:39:41 AM

Total No. Pages: 6

Subject: MK-2 Case Study

Message:

Attached is case study that was prepared originally with a great deal of Jim Philbrick's help but was later modified based on comments by NH DES.

It is crucial that this have final blessing from PSNH. WITHOUT PSNH's APPROVAL, MK-2 AND MK-1 CASE STUDIES WILL NOT BE INCLUDED IN FINAL REPORT.

This is the last, remaining item keeping report from being released. I will be very grateful for your help on this matter.

Thank you,

Jim Staudt

EXHIBIT 4

Section 4.2 SCR Case Studies

4.2.1 Case Study SCR-1: Merrimack #2 - Selective Catalytic Reduction

603

Operator Contact - Mr. Jim Philbrick: (~~620~~) 634-2280

Background

Merrimack #2 is a 333 MWg (320 MW net) wet bottom, bituminous coal-fired, cyclone boiler operated by Public Service Company of New Hampshire (PSNH) that is located in Bow, NH. The boiler, built in 1968 (installed in 1969), generates 2300 Klbs/hr of steam with 3473 MMBTU/hr heat input at maximum capacity. The 1997 capacity factor of the unit was 80% (no annual outage) and the historical (1990) capacity factor was 67% (includes annual outage). The facility was subject to NOx RACT in 1995. Uncontrolled NOx levels were 2.4 lb/MMBTU (average) or 2.66 lb/MMBTU (maximum), which is a much higher emission rate than most uncontrolled boilers and is higher than most other cyclones. This high uncontrolled NOx emission rate is due, in large part, to the very high heat release rate for this boiler which is manifested in very high full load furnace exit gas temperatures of about 2450 F. The historical coal used is 2.5% sulfur eastern bituminous, and the boiler is equipped with a tubular air preheater. However, to reduce SO_2 emissions in 1995 the sulfur content of the coal was reduced to 1.5%. Typically, 100% of the fly ash is reinjected.

The state of New Hampshire determined that 1995 NOx RACT for PSNH would be a maximum average NOx emission rate for a 24 hour calendar day of 1.4 lb/MMBTU with a daily maximum NOx emission of 35.4 tons per day, which is equivalent to 0.85 lb/MMBTU at full load for 24 hours. Hence, if continuous, 24-hour operation at full load was desired, a NOx reduction system capable of providing 68% reduction at full load was necessary. Future reductions will be required in 1999 to reduce total NOx emissions of 15.4 TPD, which is equivalent to less than 0.40 lb/MMBTU at full load or an 85% reduction from the original uncontrolled peak daily baseline.

Technology Selection

PSNH initially planned to use Selective Non-Catalytic Reduction on Merrimack #2 for NOx RACT compliance. SCR had previously been ruled out based upon the information that PSNH staff had at the time, which suggested that SCR would not be a technically viable option for Merrimack #2. Use of SNCR would require derating of the unit by over 50 MW since the furnace temperatures were too high at full load for the SNCR process to be effective. SNCR alone could not provide sufficient reductions for 1999 compliance. Reductions in 1999 would have to be achieved through some additional or other means. Initially, PSNH personnel did not believe SCR to be a technically or economically feasible retrofit option on a wet-bottom, bituminous coal-fired cyclone unit because of the large capital investment and the potential catalyst poison implications associated with fly ash reinjection.

PSNH received multiple bids for SNCR systems on Merrimack #2. None of the bidders were comfortable about installing an SNCR system on MK-2 and two of the bidders strongly suggested that SCR be considered. SCR would enable the unit to operate at full load (no derating) and would use the reagent much more efficiently. Moreover, the SCR would be able to provide sufficient reduction for the likely future NOx reductions in 1999. The catalyst suppliers assured PSNH that arsenic could be addressed, and firm guarantees would be provided for a cyclone unit. With the understanding that the SCR system would entail a much higher capital cost than SNCR, the benefits of using SCR were sufficiently compelling that PSNH decided to request proposals from multiple SCR vendors.

SCR proposals were received and PSNH found the vendors provided strong guarantees on performance and lower capital costs than were originally expected. Based upon their review of the proposals and a detailed economic/technical evaluation between SNCR and SCR systems, PSNH selected Noell as the contractor for an SCR system.

Technical Design Challenges

Several features of the facility contributed to the difficulty of the retrofit.

- The very high NOx level requires that the reactor, and ammonia handling equipment be much larger than would typically be expected for a boiler this size.
- Fly ash from the precipitator is reinjected back into the boiler, which can have the potential for shortening catalyst life. This was factored into the catalyst design.
- The large catalyst size and high sulfur content of the fuel contribute to challenges in controlling SO_2 to SO_3 oxidation to low levels.
- There were only 22 linear feet of distance between the bottom tubes of the economizer and the top tubes of the tubular air heater, providing very little room for ductwork to/from the SCR.
- The boiler is equipped with a tubular air preheater, which is not easily water washed or cleaned with soot blowers. Hence, formation of ammonium bisulfate caused by the presence of ammonia and SO_3 is a major concern.
- To limit the additional pressure drop to within the available margin in the forced draft fans, the SCR ductwork was designed for relatively low pressure drop and as a result the ductwork is relatively large.
- The new ductwork within the boiler area was supported from the existing structural steel. This steel had to be analyzed and reinforced.
- The boiler feed line to the economizer interfered with the SCR ductwork and had to be rerouted. This is high-pressure, fabricated pipe.

Fortunately, the space to place the SCR reactor was readily available with little demolition required.

The project had to face the challenges of a very fast schedule - approximately eleven months from placing the order to completion of commissioning. This fast schedule did not offer any slack time. The boiler had to be in compliance with the new, lower emission rate on the date of start up. An accelerated schedule was required for all phases of the project in order to satisfy the NOx compliance deadline. Also, the construction portion of the project was performed during a New Hampshire winter.

Merrimack #1	
MWgr	333
Klbs stm/hr	2,300
MMBTU/hr	3,473
1997 Cap. Factor	0.80
Hist. Cap. Factor (1990)	0.67
Boiler age (yrs)	28
Boiler type	Cyclone
Air heater	Tubular
Primary Fuel	coal, 1.5% S
Baseline NOx	2.4 (avg), 2.66 (max) lb/MMBTU
Controlled NOx	<0.85 lb/MMBTU

Project Execution

As mentioned, project execution was carried out by PSNH and the contractor, with construction during the winter. The excavation and foundation work was done during the fall and all above groundwork was done during the winter. The schedule was maintained by establishing good coordination with all contractors and working extended hours.

The reactor was designed to accept up to four layers of catalyst. Initial catalyst charge was two layers of 200 m^3 each, for a total of 400 m^3 of catalyst. Each layer is equipped with soot blowers to blow dust off the catalyst. An additional ½ layer was planned for addition and installed in 1997 and 1 ½ layers are planned to be added in 1999 when regulations require further NOx reductions.

A permit limit to ammonia consumption?

The system typically uses anhydrous ammonia reagent at a rate of approximately 1,900 lb/hr at full load, which is equivalent to a permit limit of 38 lb/hr as NH_3. This unusually high amount of reagent is needed due to the unit's relatively high baseline NOx emissions. The anhydrous ammonia is mixed with warm air carrier (from the air preheater) and supplied through two 90-degree grids in the ductwork upstream of the SCR.

The design and routing of ductwork was a major challenge. PSNH decided to use a large single duct at the exit of the economizer to route the flue gas to the SCR and a split to two ducts to go back to the air heater. This enabled a more balanced flow distribution out of the economizer and back to the air heater.

The project was completed on time, despite the extremely fast time frame and the difficult challenges of the program. Although there are aspects of SCR retrofits that can be more difficult than those encountered in the Merrimack #2 case, this project was a very challenging retrofit for several reasons outlined above. The total capital cost of the program, including the initial catalyst charge, was $18.4 million, or approximately 55/KW. For an 85% NOx reduction the capital cost (which includes the cost of the additional two layers of catalyst and associated equipment) is approximately $72/KW.

Experience

Since start up over two years ago, performance of the SCR system has matched anticipated performance. Catalyst samples have been tested periodically and samples are demonstrating the expected activity associated with the catalyst age. The major design parameters of the SCR catalyst initially appear to satisfy the guarantee levels.

To date, the only aspect of the SCR system that has caused any difficulty is failure of certain auxiliary mechanical equipment. These failures have included an SCR bypass damper that does not consistently provide a tight shut off, duct work casing leaks (pressurized unit and large ductwork) and failed expansion joints. The most significant concern has been the SCR bypass damper, located downstream from the ammonia injection grid, that has not consistently provided a tight shut off and produces high ammonia concentration (over 5 ppm at times) at the air heater inlet during operation. Since the boiler fires medium to high sulfur coal, 1.5% S, this results in a slow build up of ammonium bisulfate in the air heater and ultimately increased pressure drop across the air preheater. Precautions associated with increasing air heater outlet temperature have localized the buildup somewhat. However, the air heater still needs to be water washed on occasion. Notably, the SCR reactor, associated auxiliary equipment and the control system have not been the cause on an unscheduled outage to date, with the exception of the failed expansion joints. Additional water washings of the air heater have been timed to be done simultaneously with boiler outage work. Also, it has never been necessary to reduce boiler load to maintain environmental compliance because of an SCR system problem. There have been three forced outages because of premature expansion joint failures. Because of the extensive ductwork required to route the flue gas to and from the reactor, 11 expansion joints were installed in the system. PSNH and Noell are currently working on a correction to the bypass damper, which should reduce the frequency of air heater washes.

Fly ash quality has not been adversely impacted by the addition of the SCR system. All of the fly ash and boiler slag is beneficially utilized.

Operating costs have been determined by PSNH to be approximately $2,000,000/year. This estimate includes: ammonia, parasitic loads, maintenance, cost of air heater washes, boiler efficiency loss due to elevated exit temperature, the cost of catalyst testing, and engineering support. After the bypass damper is fixed, this number should decrease by approximately 10-15% because the reduced ammonia in the air heater will reduce the need to elevate air heater outlet temperature and the frequency of water washing.

Cost Effectiveness
PSNH has performed a detailed cost analysis for the use of SCR technology on Merrimack Station Unit #2. The analysis is based on a 65% NOx reduction with two full layers of catalyst and is given in 1996 dollars. The cost is $400 per ton of NOx removed. The cost components I this analysis include operation and maintenance (both fixed and variable), depreciation and the cost of money.

A detailed analysis for 1999 with 4 full layers of catalyst in the reactor and the reactor working at its maximum design capacity has not been completed at this time.

Merrimack #2	
Contract duration - Order placed to commencement of operations	~11 months
Months SCR operation (Nov. '97)	~40 months
# forced outage incidents	3
NH_3 slip, ppm	<5
NH_3 plume/year	0
Outages or reductions in capacity due to air heater plugging	0
Capital Cost	~$55/KW
Cost Effectiveness	~$400/ton NOx removed

Public Service
of New Hampshire

PSNH Energy Park
780 North Commercial Street, Manchester, NH 03101

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The Northeast Utilities System

John M. MacDonald
Vice President - Generation

RECEIVED
NEW HAMPSHIRE
DEC 07 2009
AIR RESOURCES DIVISION

December 4, 2009

NHSC B.17

Mr. Robert R. Scott, Director
Air Resources Division
Dept. of Environmental Services
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Public Service Company of New Hampshire
Request for Additional Information for Determination of
Best Available Retrofit Technology (BART) for the NH Regional Haze SIP

Dear Mr. Scott:

In response to your request, dated November 17, 2009, for additional information necessary to finalize the NH Department of Environmental Services, Air Resources Division's response to comments received from the U.S. Environmental Protection Agency and Federal Land Managers specific to DES' Best Available Retrofit Technology (BART) demonstration, Public Service Company of New Hampshire is submitting the enclosed information.

As you know, PSNH did not submit written comments specific to DES' BART determination presented at the public hearing on June 24, 2009, because PSNH was in agreement with that determination. PSNH is interested in understanding the basis of any significant changes to the BART determination and would raise objection to overly stringent BART limits that provide minimal environmental benefit yet increase costs and expose PSNH's generating facilities to permit exceedances during the course of normal operation of the units.

Incremental Cost Estimates of SO2 Reductions at Newington Unit NT1

In order to estimate incremental costs associated with varying grades of oil, PSNH evaluated historical fuel cost data provided by Platts for the period of 2002 through September 2009. Considering the inevitable inaccuracies in trying to predict future fuel prices, PSNH has calculated incremental cost estimates for illustrative purposes using the more recent historical fuel cost data (2005-2009).

As illustrated on the enclosed spreadsheet, PSNH has estimated the incremental costs, on a dollar per ton basis, of sulfur dioxide reductions at Newington Station, Unit NT1 to be as follows:

2% sulfur content by weight to 1% sulfur content by weight	\$1,030 per ton SO2 reduced
1% sulfur content by weight to 0.7% sulfur content by weight	\$2,949 per ton SO2 reduced
0.7% sulfur content by weight to 0.5% sulfur content by weight	\$7,203 per ton SO2 reduced
0.5% sulfur content by weight to 0.3% sulfur content by weight	\$12,957 per ton SO2 reduced

EXHIBIT 5

Assumptions Used to Produce Estimated Incremental Costs

The assumptions used to estimate incremental costs include historical fuel prices, maximum gross heat input rate of Unit NT1, SO2 emission rates in lb/mmBtu and lb/hr for each grade of fuel, and tons of SO2 reduced. Capacity factor of Unit NT1 is not necessary to calculate incremental costs on a dollar per ton reduced basis. The SO2 emission rates were derived from the sulfur content of the fuel, the heating value of the fuel, and the maximum gross heat input rate of Unit NT1. The tons of SO2 reduced were calculated using the delta in SO2 emissions between each fuel type on a lb/hr basis which was calculated using the SO2 lb/mmBtu emission rate for each grade of fuel and the maximum gross heat input rate of Unit NT1 as contained in Newington Station's Title V Operating Permit, TV-OP-054.

Additional Costs Associated with Fuel Storage Upgrades at Newington Station

At the present time, PSNH is hopeful that the current fuel storage and delivery system, including configuration and storage capacity, is adequate to handle varying grades of oil if required in the future. As a result, PSNH has not calculated additional costs associated with fuel storage upgrades.

MK Unit #2 Boiler and SCR Operations

The SCR has a temperature permissive that must be met in order for the SCR to be put in service or kept in service. During start-ups, shut-downs, and low load operation of Merrimack Unit #2, the temperature is lower than that permissive temperature and the SCR cannot be operated. As an example, Merrimack Unit 2 typically has 10 to 15 outages per year, in addition to approximately 8 low load operating periods per year. The timing of these conditions is not predictable and this estimate of occurrences provided reflects historical performance. Examples of low load situations include, but are not limited to: forced and planned outage start ups and shutdowns, loss of one of any equipment pair where both pieces of equipment are necessary for full load operation and the loss of one results in half load operation (such as Forced Draft Fans, Condensate Pumps), loss of the Main Boiler Feed Pump, loss of coal feeders, condenser waterbox cleaning, etc. Any condition which requires the unit be at loads below 230 mw net, causing the temperature to be below the SCR permissive will result in the SCR not able to be put in service. This load point may increase with the new, more efficient HP/IP turbine.

In addition to boiler operations and load conditions that affect SCR operation, malfunctions of the SCR system and/or associated equipment can also affect the operation of the SCR. Malfunctions of the SCR system and/or associated equipment can result in partial or complete reduction of SCR performance.

As part of normal service, the SCR catalyst becomes coated with flyash. Blinding of the catalyst with flyash can cause the SCR process control settings (often referred to as the setpoint) to have to be increased (less NOx conversion), as the reagent distribution becomes less uniform and as less catalyst is exposed to the flue gas. The SCR is cleaned as needed during outages, and sootblowers are used on line.

Reagent injection grid nozzles, being in the flue gas path, can become fouled with deposits. This can affect reagent distribution, compounding the effect of a fouled catalyst, for example. The reagent injection grid is cleaned, as needed, during outages. Also, reagent delivery disruption can occur and on-site storage is limited.

Also as a catalyst ages, it becomes less reactive. This causes a reduction in ability for NOx conversion to take place. This in itself does not typically result in higher NOx emission because the SCR has four layers of catalyst, staggered in age. However, it will compound the effect of a fouled catalyst, for example.

The uncontrolled NOx rate at reduced load and during start ups and shut-downs is typically 1.0 - 1.5 lb NOx/mmBTU. The uncontrolled NOx rate at normal full load is as high as 2.66 lb NOx/mmBTU, with an average of 2.4 lb NOx/mmBTU.

The SCR is unable to perform continually at its maximum capability due to these concerns. As a result, PSNH needs flexibility to operate the SCR based on current operating conditions.

In closing, PSNH would like to reiterate its opinion that changes to DES' BART determination that result in more stringent emissions limitations create concerns relative to increased costs and decreased operational flexibility.

Please contact Laurel L. Brown, Senior Environmental Analyst – Generation, at 634-2331 if you would like additional information or would like to meet to discuss the enclosed information further.

Sincerely,

John M. MacDonald
Vice President – Generation

Enclosure

Assumptions Used to Calculate Incremental Cost Estimates*

(A) % sulfur	(B) SO2 lb/mmbtu	(C) Max Gross Heat Input mmbtu/hr	(D) SO2 lb/hr	(E) Reduction in SO2 lb/hr		increased cost/barrel low	increased cost/barrel high	increased cost/hr low	increased cost/hr high	$/ton SO2 Reduced
2.0	2.288	4,350	9,952.8							
1.0	1.086	4,350	4,724.1	5,228.7	2% to 1%	0	$ 4.00	0	$ 2,692.86	$ 1,030
0.7	0.748	4,350	3,253.8	1,470.3	1% to 0.7%	$ 1.00	$ 3.30	$ 673.21	$ 2,167.75	$ 2,949
0.5	0.528	4,350	2,296.8	957.0	0.7% to 0.5%	$ 1.00	$ 2.20	$ 673.21	$ 3,446.86	$ 7,203
0.3	0.313	4,350	1,361.6	935.3	0.5% to 0.3%	$ 3.00	$ 9.00	$ 2,019.64	$ 6,058.93	$ 12,957

(A) % sulfur in the fuel oil
(B) SO2 lb/mmBtu emission rate, calculated based on %S and 153,846 btu/gal
(C) Maximum gross heat input rate from permit
(D) SO2 lb/hr emission rate, calculated = B * C
(E) Lbs of SO2 reduced per hour

	Actual Fuel Use	Historical Fuel Cost				
	#6 oil (barrels)	2%S oil ($/barrel)	1%S oil ($/barrel)	0.7%S oil ($/barrel)	0.5%S oil ($/barrel)	0.3%S oil ($/barrel)
2002	1,051,050	$ 21.20	$ 22.45	$ 23.26	$ 23.80	$ 25.25
2003	3,425,217	$ 24.95	$ 27.48	$ 29.26	$ 30.45	$ 32.63
2004	3,099,258	$ 25.25	$ 27.92	$ 30.04	$ 31.46	$ 34.53
2005	2,027,172	$ 37.00	$ 41.00	$ 44.00	$ 46.00	$ 50.10
2006	392,922	$ 45.50	$ 46.30	$ 48.46	$ 49.90	$ 54.12
2007	529,092	$ 53.70	$ 53.45	$ 56.54	$ 58.60	$ 62.86
2008	201,172	$ 75.25	$ 77.80	$ 81.10	$ 83.30	$ 92.16
2009	118,246	$ 49.90	$ 50.75	$ 51.98	$ 52.80	$ 55.83

Historical fuel cost data from Platts 2002-2009
2009 data includes costs through 9/09 only.

* Estimates calculated illustrate cost increases based on assumptions relied upon.

DRAFT DRAFT

PSNH MK2
NOx Control Cost Analysis

CONFIDENTIAL

Released Nov 3, 2010 per letter to PSNH

Given:

Uncontrolled NOx emission rate at full load, average Uncontrolled NOx emission rate at full load, maximum	2.4 lb/MMBtu 2.66 lb/MMBtu
NOx removal efficiency of existing SCR, average	> 0.86
Controlled NOx emission rate at full load, average Controlled NOx emission rate at full load, maximum	(1 – 0.86) x 2.4 = 0.34 lb/MMBtu (1 – 0.86) x 2.66 = 0.37 lb/MMBtu
Uncontrolled NOx emission rate at reduced load (during start-ups and shutdowns)	1.0 - 1.5 lb/MMBtu
Maximum effect of start-ups and shutdowns on 30-day average NOx emission rate, single event	0.04 lb/MMBtu
Maximum effect of start-ups and shutdowns on 30-day average NOx emission rate, multiple events	0.08 lb/MMBtu

Calculation of reduced-load time required to increase 30-day avg. NOx emission rate by 0.04 lb/MMBtu:

Assumptions: Controlled emission rate = 0.34 lb/MMBtu
Uncontrolled emission rate = 1.25 lb/MMBtu (midpoint of range)
30-day average emission rate after increase = 0.34 + 0.04 = 0.38 lb/MMBtu

Solve two equations in two unknowns:

$$
\begin{aligned}
0.34a + 1.25b &= 0.38(100\%) \\
a + b &= 100\% \\
a &= 100\% - b \\
0.34(100\% - b) + 1.25b &= 38\% \\
34\% - 0.34b + 1.25b &= 38\% \\
0.91b &= 4\% \\
b &= 4.4\% \text{ of the time, or about 30 hours/month}
\end{aligned}
$$

Calculation of estimated increase in annual maintenance costs to assure reduction in average NOx emission rate from 0.37 lb/ to 0.34 lb/MMBtu (Δ = -0.03 lb/MMBtu):

Assumptions: The essential costs are 1) the costs of additional scheduled outages for maintenance cleaning, 2) the costs of replacement power during those outages, and 3) the costs of accelerated replacement of catalyst to ensure performance.

Number of additional maintenance cleanings required = 2 (midpoint of range)
Additional annual cleaning cost = 2 x $65,000/cleaning = $130,000 (midpoint of range)
Duration of cleaning outage = 4.5 days per cleaning (midpoint of range)
Power replacement cost during maintenance outages ≈ $30/MWh
Annual power replacement cost @ 2 cleaning outages/year = $2,200,000
Annual cost of accelerated catalyst replacement = $1,000,000

Total annual cost = $130,000 + 2,200,000 + 1,000,000 = $3,330,000
Annual heat input = 3,473 MMBtu/hr x 8,760 hr/yr = 30,423,000 MMBtu @ 100% capacity factor
Annual NOx benefit = 30,423,000 MMBtu/yr x 0.03 lb/MMBtu / 2,000 lb/ton = 456 tons removed*
Cost-effectiveness = $3,330,000/456 = $7,300/ton**

* This benefit is assumed constant, regardless of number and frequency of maintenance cleanings.

** The calculated cost-effectiveness could vary by about ±40% of the indicated cost per ton, based on the following: Cleaning costs could range from $30,000-$110,000 per cleaning, maintenance outages could be as few as 1 or as many as 4 per year and last 3-6 days each, and power replacement during outages could cost $700,000-$3,300,000 annually.

EXHIBIT 6

Released Per Nov 3, 2010 Letter to PSNH

August 16, 2010

CONFIDENTIAL BUSINESS INFORMATION

Public Service of New Hampshire
Best Available Retrofit Technology (BART)
Response to Request for Additional Information

SUPPLEMENTAL INFORMATION to PSNH's July 16 Letter, Response to Request for Additional Information re: BART

As requested, PSNH provides the following information to support the Merrimack Unit #2 (MK2) NOx limits for New Hampshire's Regional Haze SIP. We are providing this information as confidential business information since it contains various operating scenarios and financial costs which are competitively sensitive in nature and could be harmful if disclosed.

Merrimack Station Unit #2: Merrimack Station was the first investor owned utility in the nation to install an SCR to achieve NOx reductions. Given the operation of the SCR, it is PSNH's position that maintaining operational flexibility is a critical priority in order to ensure continued and cost-effective compliance while simultaneously achieving significant reductions in NOx emissions. The following information summarizes the primary drivers behind the increased costs that would be incurred in ensuring attainment of NOx emissions rates lower than the current NOx emission limits set in the NH Regional Haze SIP.

1- Operational Impacts

Based on historical data MK2 typically has 10 to 15 outages per year and approximately 8 low load operations per year. During these events, SCR operating temperatures are reduced and in some instances below the SCR permissive temperature limit. The SCR temperature permissive must be met in order for the SCR to be put in service or kept in service. During start-ups, shut-downs, and partial load operation the temperature could be lower than the permissive temperature and the SCR cannot be operated. In most cases the timing of these events is not predictable.

Examples of low load situations include, but are not limited to, the following:

- Forced and planned outage start ups and shutdowns;
- Loss of one of any equipment pair. Both pieces are necessary for full load operation and the loss of one results in half load operation (such as forced draft fans, condensate pumps);
- Loss of the main boiler feed pump;
- Loss of coal feeders, condenser waterbox cleaning, etc.; and
- Any condition which results in the flue gas temperatures to be below the SCR permissive temperature will result in the SCR not able to be put in service.

A more stringent limit could result in the unnecessary shutdown of the unit rather than operating at partial load. An example of this scenario has occurred in the past when a critical pump failed which restricted full load operation. While the pump was repaired the unit remained operating

EXHIBIT 1

but at a reduced capacity, the duration of this event was approximately 240 hours. PSNH's customers received significant benefit from this partial load operation. Replacement power costs associated with this type of event are shown in the Table 1.

Replacement Power Costs: The table below uses an assumption of $30/mwhr difference between the cost of MK2 and the market cost. This number can vary greatly depending on energy market prices.

Table 1a. Cost Associated with De-rate Flexibility at 0.37 lb/MMBtu Assumes 0.64 tons per hr				
Duration of De-Rate	De-rate Capacity	Remaining Capacity Online	Avoided Replacement Power Cost	Cost per ton
240 hr	132 MW	200 MW	$1,440,000	$0
100 hr	132 MW	200 MW	$ 600,000	$0
50 hr	132 MW	200 MW	$ 300,000	$0

Table 1b. Cost Associated with limited De-rate Flexibility at 0.34 lb/MMBtu Assumes 0.59 ton per hr				
Duration of De-Rate	De-rate Capacity	Remaining Capacity Online	**Un-avoided** Replacement Power Cost	Cost per ton
240 hr	132 MW	200 MW	$1,440,000	$10,169
100 hr	132 MW	200 MW	$ 600,000	$10,169
50 hr	132 MW	200 MW	$ 300,000	$10,169

The opportunity for partial load operation during high demand periods would be even more costly to both reliability and to customers. The example mentioned above resulted in a long duration of partial load operation but it is important to note that during periods of high energy prices a much shorter event could also have significant cost. For example, assuming a $100 per MWh market price, operating at 200MW partial load for a period of 12-hours would avoid $240,000 of replacement power cost. During this period a NOx reduction of approximately 7 tons would be realized which equates to $34,000 per ton NOx. Under some of these scenarios partial load operation would be eliminated to ensure consistent compliance with the proposed NOx limit reduction.

2 – Maintenance Impacts

PSNH's highest priority is ensuring compliance with all emission limits. PSNH has reviewed historical data and concluded that start-ups, shut downs partial load operating conditions and upsets can significantly impact a calendar month average emission rate. To account for these events PSNH operates NOx control equipment to maintain a NOx emission rate of approximately 0.25 lb/MMBtu calendar month average. In order to ensure compliance with the 15.4 ton/day limit or the equivalent 0.37 lb/MMBtu emission rate, PSNH targets a 0.15 lb/MMBtu difference between the average NOx emission rate and the specific limit. Further limitations would impact operation and increase incremental maintenance and capital cost.

In addition to boiler operation and load conditions that affect SCR operation, malfunctions of the SCR system and/or associated equipment can also affect the operation of the SCR. Malfunctions of the SCR system and/or associated equipment can result in partial or complete reduction of SCR performance.

Also, as part of normal service, the SCR performance degrades overtime. One reason this occurs is due to blinding of the catalyst with fly ash. This condition will cause the SCR process control settings to compensate by increasing SCR loading to maintain the set point. This is necessary because the reagent distribution becomes less uniform as less surface area of the catalyst is exposed to the flue gas. To manage this condition from developing to the point that a maintenance outage is necessary, the SCR is cleaned on-line utilizing soot blowers and cleaned during outages, as needed. Increased SCR loading could lead to more frequent maintenance outages. It is anticipated that a minimum of three additional SCR cleanings and air heater washes would be necessary to maintain compliance with the 0.34 lb/MMBtu proposed NOx limit. Cleanings are expected cost between $30,000 and $100,000 as noted below in item 3. Replacement power costs associated with the necessary maintenance outages are also described in item 3 below.

Additionally, reagent injection grid nozzles are directly exposed to the flue gas and become fouled over time. This can affect reagent distribution, compounding the effect of blinded catalyst. The reagent injection grid is cleaned, as needed, during outages. Also as catalyst ages, it becomes less reactive. This causes a reduction in ability for NOx conversion to take place. This in itself does not typically result in higher NOx emissions because the SCR has four layers of catalyst, intentionally staggered in age. However, increased loading of the SCR catalyst would be necessary to maintain compliance with the proposed reduction in NOx limit and accelerate catalyst degradation. For example, the SCR is unable to perform continually at its maximum capability. As a result, PSNH needs flexibility to operate the SCR based on current operating conditions. Currently the SCR averages greater than 86% efficiency.

Each catalyst layer has an anticipated functional life of 8 years and each layer is staggered in age to accommodate replacing one layer every 24 –months. Further NOx limitation would increase loading of the SCR and could result in accelerated catalyst degradation requiring premature replacement. This would result in a loss of investment. Even if minor catalyst degradation occurred reducing the catalyst useful life from 8 years to 7.5 years the replacement schedule would need to be adjusted. The change in replacement schedule is necessary because catalyst replacement projects must coincide with MK2's overhaul schedule which is on a 12-month cycle. PSNH would incur a loss of investment of approximately $143,000 annually due to the early replacement. It is also important to note that the revised replacement plan would result in minimal reductions to the total reduced tons of NOx for the year, but rather be put in place to avoid the periodic increased emission rates at the end of the catalyst life. As shown below in Table 2, PSNH believes minimal catalyst replacement and maintenance cost are associated with the 0.37 lb/MMBtu rates provided certain exceptions for start-up and shutdown and malfunctions.

Table 2. Incremental Maintenance and Capital Cost				
Emission Limit (lb/MMBtu)	Calendar Month Control Target (lb/MMBtu)	Annual Loss of Investment of SCR Catalyst	Increase Maintenance (Cost of Air heater and SCR Maintenance)	Predicted Incremental Cost
0.37	0.22	$0	$0	$0
0.34	0.19	$143,000	$195,000	$338,000

3 –Replacement Power Costs associated with the Proposed Reduction in NOx Emission Rate

Merrimack Station will need to consider a number of additional compliance efforts if not provided the necessary flexibility to deal with short-term events as described above and the operational restrictions of the SCR. Each has an additional cost as outlined below.

There will be increased maintenance costs to maintain peak NOx reduction capability. For example, air heater and SCR cleanings will be required more frequently because of increased loading of the SCR. This results in additional maintenance costs and replacement power costs associated with the required outages. It is anticipated that at least one additional 4.5 day (mid) maintenance outage would be necessary to maintain compliance with the 0.34 lb/MMBtu proposed limit. In addition to the maintenance outage additional cleaning will be completed as a proactive measure during forced outages resulting in delayed start-ups. Outage duration is from time offline until the unit is phased.

If air heater washing were completed to comply with a step change in the NOx rate as shown below, the cost per ton of NOx reduction would be extremely costly. Again this number can increase greatly if an air heater cleaning was completed during a high priced market.

Table 3. **Potential** Emission Summary (8760 hrs)		
Emission Rate Lb NOx/mm BTU	NOx tons emitted per year	Incremental reduction in **Potential** emissions tons per year
0.37	5628.34	0
0.34	5171.99	456

Maintenance (Cleaning) Costs: $30,000 to $100,000 per cleaning

Replacement Power Costs: The table below uses an assumption of $30/mwhr difference between the cost of MK2 and the market cost. This number can vary greatly depending on energy market prices.

Table 5. Impact of 0.34 lb/MMBtu Limit	
Duration of Cleaning/Outage	Replacement Power Cost per Outage
Short (3 days)	$720,000
Mid (4.5 days)	$1,100,000
Long (6 days)	$1,400,000

It should be reiterated that these compliance measures are focused solely on the shorter duration events that typically occur at lower loads with less heat input and for a discreet period of time thus do not result in the emission of a significant amount of NOx emissions. To meet the proposed rates of 0.34 lb NOx/MMBtu, under the conditions referenced above, PSNH may be forced to shutdown for air heater/SCR cleaning and also may be forced to shutdown rather than operate at partial load. Each of these aforementioned scenarios has significant cost as described above.

Also, with out exceptions for short term operational conditions additional incremental costs may be incurred when considering a calendar month averaging period. PSNH may be forced to delay start-up to maintain a 0.34 lb/MMBtu calendar month average. It is important to note that start-up shutdowns, and partial load operating scenarios may bias a lb/MMBtu rate but typical result in low tonnage emission total. To manage for this situation it may be necessary for PSNH to adjust the current operating strategy by delaying start-ups or to prevent a short operating periods during the calendar month. Table 6., below illustrates the potential cost with delaying an outage start-up.

Table 6. Replacement power cost associated with delayed start-up			
	Cost delta with the Market	Total cost of Outage for customers	Cost per Ton *
1 day	$30	$239,040	$15,936
	$40	$318,720	$21,248
	$50	$398,400	$26,560
2 days	$30	$478,080	$31,872
	$40	$637,440	$42,496
	$50	$796,800	$53,120

*assumes saving of 15 tons per day

4 - Summary of Analysis

Merrimack Station has had a program in place to reduce NOx emissions for the past 15 years. The reductions in total annual emissions reflect that laudable effort. Going forward, Merrimack Station anticipates continuing that effort, while maximizing customer value and providing reliable and affordable power. It is critical to understand adjusting the NOx rate will significantly increase the incremental costs of compliance without significantly decreasing total NOx emissions. This effort will have virtually no effect on MK2's actual emissions and is focused on limiting MK2's potential emission which results in eliminating operational flexibility and increasing operating costs. Table 7. below is a summary of the incremental costs that PSNH will incur when considering the 0.34 lb/MMBtu proposed NOx emission rate.

Table 7. Summary of Additional Predicted Annual Cost

Emission Limit (lb/MMBtu)	Calendar Month Control Target (lb/MMBtu)	Loss of Investment of SCR Catalyst per year	**Un-avoidable** Replacement Power cost (Partial Load) @ 240 hrs	Increase Maintenance (Cost of Air heater and SCR Maintenance) 3 per year	Replacement Power Cost For Maintenance Outage at $30 MWH	Delayed start-up to clean SCR and Air Heater 2days (One day each for two outages)	Incremental reduction in **Potential** tons per year	Predicted Incremental Cost Increase $/yr	Cost per ton
0.37	0.22	$0	$0	$0	$0	$0	0	$0	$0
0.34	0.19	$143,000	$1,440,000	$195,000	$1,100,000	$478,080	456	$3,356,080	$7,359

This analysis demonstrates that the implementation of a 0.34 lb/MMBtu or more stringent rate will result in significant cost to our customers with little environmental benefit. This is true because a lb/MMBtu rate could result in running the SCR harder, more frequent air heater cleaning, extended outages, and forced outages, and limit partial load operation.

PSNH would be happy to meet with you and your staff to discuss the information provided above. If you have questions or require additional information, please contact Lynn Tillotson at 634-2440 or Sheila Burke at 634-2512.

cc:
Elizabeth H. Tillotson, TBM, Generation Staff
Sheila Burke, Generation Staff
Tara Olson, Newington Station